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and the Description of Two New Subspecies of *Holbrookia***

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Howard K. Gloyd, Director.

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**A Solution to the Long Neglected *Holbrookia lacerata* Problem,
and the Description of Two New Subspecies of *Holbrookia***

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An interest in the lizard genus *Holbrookia* that dates back to my high school days in southern Texas has burgeoned to the point where a monographic treatment of the group is now in preparation. During the earlier phases of research with the Texas members of the genus, a taxonomic problem came to light which I feel should be published preliminary to the full report. This problem, and the concomitant description of two new subspecies which are a result of the study, is to be presented here.

Without the cooperation and assistance of many of my friends and associates an undertaking such as this could never have been realized. I am wholeheartedly grateful to the following people and institutions.

For the many courtesies afforded me by the persons in charge of the collections at various institutions, and for loan of specimens, I would like to thank Dr. Doris M. Cochran of the U. S. National Museum (USNM), Dr. Charles M. Bogert and Bessie M. Hecht of the American Museum of Natural History (AMNH), Dr. Bryce C. Brown of the Baylor University Museum (BUM) and for the loan of his private collection (BCB), Dr. W. B. Davis of Texas A. and M. College (Texas Cooperative Wildlife Collection—TCWC), Dr. Carl D. Riggs and Dr. Charles C. Carpenter of the University of Oklahoma Museum of Zoology (UOMZ), Dr. Edward H. Taylor and John M. Legler of the University of Kansas Museum of Natural History (UKMNH), and Dr. Norman Hartweg, Dr. William E. Deullman and Jack Damon of the University of Michigan Museum of Zoology (UMMZ). For gifts or loans of specimens from individuals, I would like to thank M. J.

Fouquette, Dr. J. S. Mecham, Dorothy Trevino Robinson, George G. Henderson, John E. Werler, Michael Robinson, and Dr. Pauline James. Specimens in my personal collection are marked RWA.

I wish especially to thank Dr. Marshall C. Johnston, James R. Tamsitt, and Dr. Henry H. Hildebrand for their companionship and assistance in the field. Mr. Tamsitt deserves special mention for securing and observing both *Holbrookia lacerata* and *Holbrookia maculata* in the zone of sympatric overlap near Big Spring, Texas.

Credit for the photographs should go to Isabelle and Roger Conant, who graciously lent their time and ability while snowed under with work on the forthcoming Field Guide. Mr. Conant has carefully read the manuscript and offered many helpful suggestions.

Finally, I thank Dr. W. F. Blair and the Texas Natural History Collection (TNHC) of the University of Texas for making available specimens, space and material for carrying on my research. Dr. Blair has read the paper and offered valuable suggestions and criticisms.

HISTORY OF THE PROBLEM

The problem is an old one, dating back to the description of *Holbrookia lacerata* by Cope (1880). At that time, Cope supplied an excellent description of the material he had at hand, but included along with his definition, locality "records" from two rather widely separated areas (about 120 airline miles) in Texas. Quoting from Cope: "The most northerly locality for *Holbrookia lacerata* [with which I am acquainted is in Erath County, west of the upper Brazos. Mr. Boll found it rather abundantly there and in Comanche County. Southward it has been found by Mr. Marnock on the Guadalupe River in Kendall or Comal County." It should be pointed out that Cope cited no definite locality records, nor did he indicate whether he possessed specimens from either of the two regions mentioned in the quotation above. I have been unable to find specimens antedating Cope's work from either of these areas. I did find two specimens in the U. S. National Museum, however, which are marked as types. One of these (USNM 10160A) a male, fits Cope's description almost perfectly. These two cotypes were collected by G. W. Marnock, but were reported from Helotes, Texas, which is not on the Guadalupe River. It is possible that Marnock might have collected the cotypes on the Guadalupe River, and shipped the specimens from Helotes without locality data. Shipping points rather than actual locality records have the notorious habit of slipping into museum catalogs. In this case little harm is done because Helotes happens to be in, or at least very near, the known range of the lizard described.

Cope's use of plural locality data served as the initial point of confusion regarding the interspecific relationships of the lizard he was describing. By citing information for two well-separated localities, Cope, as will be shown presently, innocently included two distinct species (*H. lacerata* and *H. maculata*) under the single specific name *Holbrookia lacerata*.

Several papers subsequently were published which tended to perpetuate the initial confusion instead of alleviating it. Stejneger (1890) reduced the newly described *H. lacerata* to a subspecies of *Holbrookia maculata*, and was the first and only worker to point out the identity of the types as associated with the Helotes type locality. Although Stejneger recognized only one type locality, he continued to lump the type specimens from Helotes with the specimens from north central Texas, just as Cope had originally done. Cope (1900), himself adopted Stejneger's views and treated *lacerata* as a subspecies of *maculata*. Schmidt, who published the first comprehensive review of the genus *Holbrookia* (1922), enumerated the difficulties encountered in distinguishing certain *H. lacerata* from *H. maculata*. He recognized several of the paramount characteristics of *H. lacerata*, such as the distinctive dorsal coloration and markings, the subcaudal black spots, and the variable lateroventral black spots, but he regarded these characters as unstable since some of the material he examined did not exhibit them. Although Schmidt listed "authentic" localities¹ in seven Texas counties (Crockett, Kerr, Kendall, Bexar, McLennan, Erath and Comanche), he failed to notice any geographic discontinuity in the incidence of subcaudal spotting. I will show that such discontinuity does exist.

Schmidt apparently was not swayed by the changing views of his predecessors with regard to the subspecific status of *H. lacerata*, because he continued to recognize it as a full species. In the latest checklist (1953), this point of view is retained, but the original double type locality is also retained.

General works, mostly checklists, regional lists, and handbooks which have appeared since 1922, have tended to follow the views of Stejneger (1890) by considering *lacerata* a subspecies of *H. maculata*. Smith (1946) included a section on *Holbrookia* which is perhaps the most detailed treatment of the genus thus far. Smith employed the original

¹ Schmidt's use of the term "authentic" is ambiguous, as he was able to examine only six specimens. These six specimens could have hardly come from seven different counties. The word authentic implies first hand identification by the investigator, not the allocation of literature records.

dual type localities for *lacerata* and recognized it as a subspecies of *Holbrookia maculata*.

DISCUSSION AND DESCRIPTIONS

Now that a considerable quantity of material is available from a large number of localities, it can be shown that the *Holbrookia lacerata* of earlier workers consists of two distinct species. These are :

Holbrookia lacerata, which has very distinctive subcaudal spots, a vivid dorsal pattern of light-margined dark blotches arranged on a grayish-brown ground color, and inhabits the Edwards Plateau of Texas and regions to the southward.

Holbrookia maculata, which has no trace of subcaudal *spotting* (*H. m. dickersonae* sometimes has dark pigmented *bands* on the subcaudal surface), a vivid or obliterated dorsal pattern of dark blotches with light posterior margins on a tan, brown or gray ground color, and is found north and west of the Edwards Plateau, and on the plains of the Mexican tableland.

The peripheral, more easterly distributed *H. maculata*, which has been confused with *Holbrookia lacerata* for so long, can be easily distinguished from the populations of *H. maculata maculata* inhabiting the sandy Great Plains and Llano Estacado. As there has been no name other than *lacerata* (now preoccupied) applied to this eastern assemblage of lizards, I suggest that it be called

*Holbrookia maculata perspicua*² ssp. nov.

Plate I, Figures 1 and 2

Holbrookia lacerata Cope, U. S. Nat. Mus. Bull. 17, 1880, p. 15 (part). — Schmidt, Bull. Amer. Mus. Nat. Hist. vol. 4-6, 1922, p. 718 (part). — Schmidt, Checklist N. Amer. Amph. Rept., 6 ed. 1953, p. 120 (part).

Holbrookia maculata lacerata Stejneger, N. Amer. Fauna, no. 3, 1890, p. 109 (part). — Smith, Handbook of Lizards, 194-6, p. 122-124 (part). — Smith and Taylor, U. S. Nat. Mus. Bull. 199, 1950, p. 83 (part). — Brown, Checklist Rept. Amph. Texas, Baylor Univ., 1950, p. 91 (part).

Holotype. Adult female, UOMZ 10953, collected May 20, 1931. *Type Locality*. 2.5 miles northeast of Norman, Cleveland County, Oklahoma.

Distribution. (See map, Fig. 1). Geographically adjacent to and east of *H. m. maculata* in south central Kansas and western Oklahoma. In

² In reference to the underside of the tail of this saurian which is perspicuous, or unmarked.

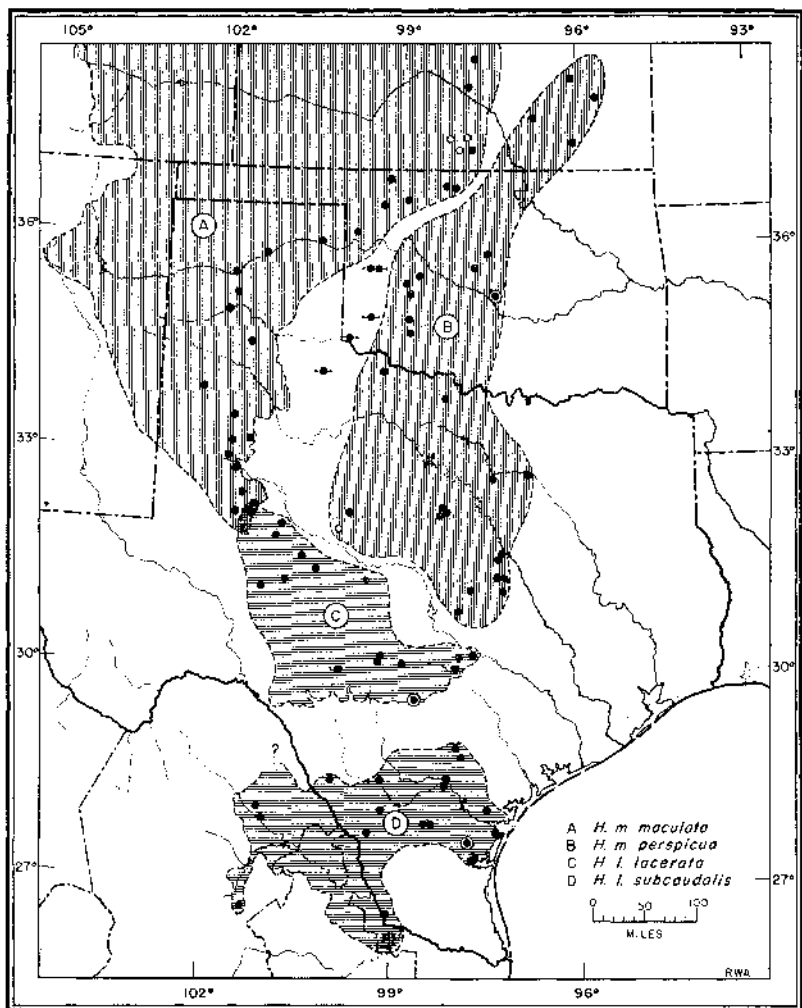


Fig. 1. Map of the hypothetical range of several subspecies of *Holbrookia* with dots representing actual locality records. Specimens examined are represented by solid dots. Only locality records on the eastern periphery of the range of *H. m. maculata* have been included.

Texas the ranges of *perspicua* and *maculata* become separated in the region of Cottle, King and Stonewall counties near the eastern base of the Panhandle, and exhibit no indication of intermediacy or intergradation south of that region. Discontinuous populations of *perspicua* occur south to Taylor and Runnels counties, and east to Burnet, Williamson, McLennan, and Dallas counties in Texas. In general, this lizard is distributed on "islands" of suitable habitat in the extensively eroded, dissected or "cut" plains of Texas, Oklahoma, and southeastern Kansas.

Vertical range is from approximately 700 feet in Bell County, Texas, to about 1,800 feet in Washita County, Oklahoma.

Diagnosis. Size small, maximum snout-vent length 61 mm.; tail the same length as, or shorter than, body in 86 per cent of adult males, always shorter than body in females and juveniles; femoral pores 8 to 16, average 12.9; no, or only slight, light dorsal speckling in males; scales enlarged along lateral fold; lateral black bars 2 to 3 on each side; dorsolateral light stripes present only on the neck, obscured posteriorly by confluent dorsal and lateral body blotches. Coloration in alcohol tan or buff, with usually two series of darker brown transverse bands or blotches commencing from the occipital region to the tip of tail; these bands are usually light-edged posteriorly and concave anteriorly. The lateral fold, although patterned, is lighter than the dorsal surface; venter immaculate white; throat mottled with grayish. No subcaudal spots.

Description of Type. Head blunt, profile (viewed from the side) a convex curve from occipital region to snout; dorsal head scales rather smooth, with minute pits, and slightly enlarged in the frontal parietal region; five internasals; 2-2 canthals; 6-6 superciliaries; enlarged supraoculars, about 11 in number, moderately enlarged and tending to form rows; uneven rows of rugose, granular circumorbitals separating supraoculars from frontals and parietals; one subocular, three preoculars, two postoculars, all keeled; interparietal circular, smooth; parietals sub-equal in size, forming two uneven rows of supraorbital semicircles, supra-labial region flared; six imbricate and keeled (except the last) supralabials on both sides; rostral when viewed from front triangular, flared laterally, strongly overlapped by first supralabial on each side; infralabials eight (R) and nine (L) to point opposite last enlarged supralabial; mental and postmental fused, top-like in shape; symphyseal fold present, 2.8 mm. long, with median granular scales; lorilabials enlarged, one row wide anteriorly, three rows wide posteriorly; remainder of gular region with scales subequal in size, decreasing slowly in size posteriorly; two gular folds, both deep and with granular scales in their depressions; posterior gular fold bordered anteriorly by enlarged mesoptichials covering the

granular scales of the fold which extends dorsally on either side of the body slightly anterior to the insertion of the forearm and terminates low on the shoulder ; scales of trunk non-mucronate, granular, increasing in size only in median dorsal region ; scales along vertebral line about twice the size of adjacent laterals, and weakly keeled ; scales of lateral dermal fold slightly enlarged ; fold margined below with very minute scales ; scales on outer surface of legs weakly keeled, on undersurface not ; scales of femur enlarged anteriorly, decreasing slowly in size posteriorly to become granular on the posteroventral surface of the leg, then abruptly increasing in size at the femoral pore line ; ventrals two to three times larger than dorsals, flat, smooth ; scales on soles of feet keeled ; lamellae on rear phalanges sharp pointed when viewed in profile, with two to three longitudinal ridges and points per scale ; dorsal portion of tail with slightly keeled scales proximally, increasing in rugosity distally ; proximal part of the tail not keeled ventrally ; many dorsal caudal scales with apical pits.

Color in alcohol : Dorsal ground color brownish-gray with two series of very distinct darker brown blotches extending down each side of the vertebral line from behind the occiput to the base of the tail ; thickened portions of the blotches are concave anteriorly, convex, light-edged and slightly serrate posteriorly ; each dorsal vertebral blotch has an adjacent lateral secondary blotch (usually connected to it) which is slightly lighter in color and not so well defined ; these blotches extend to the lateral fold and disappear ; secondary lateral blotches on the neck elongated ; all dorsal blotches paired ; tail with three paired markings anteriorly, five V-shaped markings posteriorly ; head with darkened transverse frontal and supraocular bands ; limbs distinctly marked with dark brown bands above, cream-white below ; venter dull cream-white, with grayish oblique bars on chin and lateral neck region ; area below lateral fold suffused with grayish pigment ; two distinct, oblique lateral abdominal black bars on each side of body, with slight indication of third bar on right side ; underside of tail immaculate, colored as the venter.

Snout to vent 53.1 mm.; tail 37.1 mm. (ratio, tail to total length .411) ; hind leg 34.1 mm. (ratio, hind leg to snout-vent measurement .642) ; femoral pores 12-11 ; lamellae on fourth toe 22-21 ; ventrals from gular fold to anus 69.

Comparisons. This lizard represents a rather distinct pattern modification of *Holbrookia maculata*. The well-defined pattern of dark blotches on a light brown ground color, and the absence of any superficial white speckling, will usually identify the males immediately. The females are more difficult to identify, but both sexes usually have several

of the lateral pairs of blotches connected by coalescence of the dark-blotch pigment medially, thus forming an elongate serrated band instead of a blotch. In *H. m. maculata* this conjugation of the lateral series of blotches with the dorsal series is rare, for the space between the blotches is usually filled by a patch of white scales which gives this race a characteristic striped appearance. Although a similar white patch is frequently present in the serrated cavities of the posterior margin of the blotches in *H. m. perspicua*, the striped appearance tends to be nullified by fusion of the blotches and by the maintenance of a normal shade of ground color in front and back of the blotches. A lightening of the ground color along a line continuous with the white patches in *H. m. maculata* enhances its striped appearance. So far as scutellation and measurements are concerned, this lacertilian cannot be distinguished from all *H. m. maculata*. Several specimens from western Oklahoma and north central Texas (see Fig. 1) are considered intergrades between *H. m. perspicua* and *H. m. maculata*. The intergrades tend to approach *perspicua* slightly more than *maculata* in pattern. The dearth of material from the zone of intergradation prevents a more adequate evaluation of its dimensions.

For many years this race has been confused with *H. lacerata*. One of the causes of this confusion has already been discussed, but another cause seems equally important—the pattern similarities between *H. m. perspicua* and *H. lacerata*. Living specimens of both species, when compared with each other, pose no identification problem because of their different coloration, but preserved material is easily confused if the subsurface of the tail is not examined, or if this member is missing. An example is afforded by plate 18, page 123 in Smith, 1946. Photographs A and B are of *H. lacerata*, whereas C and D are *H. m. perspicua*. The sharply defined pattern and the tendency for the lateral series of blotches to become confluent is remarkably similar in both lizards.

H. m. perspicua can be distinguished from *H. lacerata* by absence of subcaudal markings, a narrow, more rounded head, distinct, fairly large lateral abdominal black bars, dorsal body scales flattened or sometimes keeled (but never concave), and by the absence of any light pigmented scales on the anterior margins of the dorsal body blotches.

Habitat. In Texas, only isolated islands of suitable habitat are frequented by this *Holbrookia*. Although the habitat types on these various "islands" are quite variable (from rolling grassy loam prairie to sandy oak woodlands), it is interesting to note that the populations of lizards inhabiting these "islands" have undergone little phenotypic divergence, and perhaps may be called young, evolutionarily speaking.

The rather extensive erosion which has stripped off Cretaceous limestones and exposed Pennsylvanian and Permian deposits in the Brazos River basin of central Texas evidently had much to do with the eventual breakup of earlier population panmixia which must have prevailed over a rather broad area at one time. The shaded area on Figure 1 possibly delimits the distribution of this original panmictic population. As the subpopulations referred to *perspicua* from Texas, Oklahoma, and Kansas show definite affinities, even though the various populations are disjunct allopatrically, I feel justified in treating them as a single system which has not yet reached any taxonomic level of divergence.

SPECIMENS EXAMINED

Holbrookia maculata perspicua 78).

KANSAS: *Butler Co.*-1 mi. w. Keighly (UKMNH 17903). *Elk Co.*-no specific locality (UKMNH 200-212). *Woodson Co.*-Neosho Falls (USNM 4692).

OKLAHOMA: *Beckham Co.*-8 mi. e. and 2.2 mi. s. Sayre (UOMZ 23883). *Canadian Co.*-2 mi. s. Piedmont (UOMZ 9957). *Cleveland Co.*-2.5 mi. n.e. Norman (UOMZ 10953) ; 6 mi. n. Norman (UOMZ 6500) ; n. edge Crystal Lake (UOMZ 23061). *Comanche Co.*-Wichita Mts. Wildlife Refuge (UOMZ 26671) ; Mayers (prob. Meers) (USNM 44981). *Custer Co.*-Weatherford (UOMZ 2342, 2344). *Kiowa Co.*-Coopertown (UOMZ 23321). *Logan Co.*-s.w. part of county (UOMZ 20149). *Washita Co.*-Bessie (UOMZ 2340) ; Cloud Chief (UOMZ 2260).

TEXAS: *Bell Co.*-4 mi. w. Killeen (TCWC 5641, 5642) ; 2 mi. e. Temple (TCWC 7200). *Burnet Co.*-10 mi. n.w. Bertram (RWA 784). *Clay Co.*-Henrietta (USNM 32908-13). *Dallas Co.*-3 mi. s.w. Dallas (USNM 83128). *Erath Co.*-6 mi. w. Stephenville (TCWC 5638) ; 9 mi. s.e. Stephenville (TCWC 5634, 5636, 5637) ; Stephenville (TCWC 5639). *McLennan Co.*-China Spring (BUM 5547, 6032, 6033, 6035, 6055) ; 3 mi. s.w. China Spring (BUM) ; 4 mi. w. China Spring (BUM) ; 6 mi. n. China Spring (BCB 2747) ; 5 mi. n. China Spring (BCB 2862) ; 18 mi. from China Spring (USNM 22150-1) ; Eddy (BUM 5916-21, 5821-2, 5824-5, 5708, 5802) ; Moody (BUM 5398). *Tarrant Co.*-Benbrook (BUM 4221) ; (RWA 854-8). *Taylor Co.*-Tuscola (BCB 2118-9). *Wilbarger Co.*-Vernon (BUM 4690).

Holbrookia maculata maculata X *maculata perspicua* 14).

OKLAHOMA: *Greer Co.*-4 mi. n. Mangum (UOMZ 4670). *Roger Mills Co.*-Antelope Hills (UOMZ 4712) ; Hammon (UOMZ 12466-71) ; probably near Strong City (UOMZ 2180-81).

TEXAS: *Cottle Co.*-13 mi. n. Paducah (TNHC 1056-1059).

Since the status of *Holbrookia lacerata* has been highly confused in the literature, it may be well to re-diagnose the species in the light of evidence now at hand.

Holbrookia lacerata Cope

Holbrookia lacerata Cope, U. S. Nat. Mus. Bull. 17, 1880, p. 15 (part). — Schmidt, Checklist N. Amer. Amph. Rept., 6 ed. 1953, p. 120 (part).

Holbrookia maculata lacerata Stejneger, N. Amer. Fauna, no. 3, 1890, p. 109 (part). — Smith, Handbook of Lizards, 1946, p. 122 (part). — Smith and Taylor, U. S. Nat. Mus. Bull. 199, 1950, p. 83 (part). — Brown, Checklist Rept. Amph. Texas, Baylor Univ., 1950, p. 91 (part).

Lectotype. Adult male, USNM 10160A, collected in May 1879, by G. W. Marnock.

Type Locality. Within a circle with a three mile radius from Helotes³, Bexar County, Texas.

Distribution. (See Fig. 1) Two subpopulations exist and from all present indications they seem to be disjunct. One of these populations is distributed discontinuously on the dark limestone derived soils of the Edwards Plateau of Texas, and the other population frequents the dark clay and sandy clay soil areas from the Gulf coast near Corpus Christi, Texas, west to the foothills of the Sierra Madre Oriental in northern Coahuila, Mexico. Vertical distribution for the species is from sea level to 2,700 feet.

Diagnosis. A rather small, earless, iguanid lizard with dark sub-caudal spots (not bands) ; a dorsal pattern of light-bordered dark blotches on each side of the vertebral line extending from the occipital region to the tip of the tail ; no dorsal light speckling in adults or young of either sex ; tail markings longitudinally split, seldom forming chevrons ; a distinct or indistinct series of lateral abdominal black markings varying from none to five in number, and, when present, usually oval in shape, not elongate dorsoventrally; femoral pores vary from 10 to 20 on each side, average 14.4 for the species ; average snout-vent length 57.2 mm.

Relationships. The species *Holbrookia lacerata*, with its dark sub-caudal spots, might well be interpreted as a phenotypic link between two allied groups of lizards : (1) the *Holbrookia texana* and *Callisaurus* type of lizard with strong black crossbanding on the ventral surface of the tail ; and (2) the *Holbrookia maculata* type lizard in which the sub-

³ I prefer not to restrict the type locality to the small town of Helotes, for the lizard might not occur there. Marnock actually lived several miles north of Helotes.

caudal markings are absent. Other structural and pattern characteristics indicate, however, that *lacerata* is much more closely allied to the phylogenetic line of *H. maculata*. A complete discussion of the phylogeny of these and other related forms will be presented in a forthcoming revision of the genus *Holbrookia*.

Holbrookia lacerata comes into sympatric overlap with two other species of the genus—*H. texana* and *H. maculata*. It is in contact with *H. t. texana* on the Edwards Plateau of Texas, and with *H. m. maculata* in the Big Spring area of Texas. Although *lacerata* occurs within less than one-half mile of *H. propinqua* in southern Texas, a sharp ecological barrier (aeolian sands) keeps the two populations allopatric.

H. lacerata is easily distinguished from *H. texana* by its dorsal pattern of well defined light-edged blotches, by its tail which is circular in cross section and not dorsoventrally flattened, and by the small, dark lateral abdominal spots which are confined to the lateral fold area—no extensive black sweeping arcs as in *texana*. The subcaudal markings are rounded spots which tend to show decrease in pigmentation posteriorly. In *texana* the subcaudal markings tend to form transverse bands that show no reduction in pigmentation, except occasionally near the anus.

Smith (1946, p. 123-4) calls attention to a specimen of *H. m. approximans* (UMMZ 69058) from Potter County, Texas with "one large subcaudal spot (perhaps more originally present, tail regenerated)." I have re-examined this lizard and find it to be a female *Holbrookia texana*.

In the Big Spring region where *H. lacerata* occurs with *H. m. maculata*, *lacerata* may be distinguished by the presence of subcaudal dark markings, the absence of light speckling in adult males, a well defined pattern of light-edged grayish-black blotches on a ground color of brownish-gray, and lateral abdominal dark markings which are oval in shape and not elongate dorsoventrally.

The relationships of *H. lacerata* with *H. m. perspicua* have been discussed under the description of the latter and need not be repeated here. Suffice it to say that the two forms are disjunct in distribution but display considerable parallelism in dorsal pattern design. This parallelism certainly seems adaptive, for the soil types in both areas show similarities both in color and texture.

I have been able to assemble a fairly representative sample of *Holbrookia lacerata* from ten southern Texas counties and from three localities in the Mexican state of Coahuila. As the lizards in the sample exhibit both pattern and meristic characters which distinguish them from

the Edwards Plateau populations, I suggest that they be called

*Holbrookia lacerata subcaudalis*⁴ **ssp. nov.**

Plate II, Figures 1 and 2

Holotype. Adult male, Texas Natural History Collection 20,000 (original RWA 1163), collected June 6, 1955, by R. W. Axtell.

Type Locality. In plowed field 4.8 mi. east northeast of Bishop, Nueces County, Texas. Elevation 75 ft.

Distribution. (See map, Fig. 1). This is a lizard which occurs in dark clay or clay loam soil habitats in southern Texas and extreme northeastern Mexico. This habitat, which supports a predominantly mesquite-prickly pear cactus association, extends from the vicinity of Corpus Christi on the Texas Gulf Coast, northward to Karnes County and westward to Dimmit County in Texas. The Mexican distribution, with only three localities available for reference, is tentative, but I have outlined a possible range (Fig. 1) on the basis of personal observation of the soil type and vegetation in the questionable area. The remainder of the Texas range follows the Rio Grande north from Falcon Dam, skirting the sandy soil habitat of *Holbrookia propinqua* which lies to the east, and continues eastward to the coast at Baffin Bay. Vertical distribution is from sea level to about 2,700 feet.

Diagnosis. A small, earless, iguanid lizard with dark subcaudal spots and a pattern of light-bordered dark dorsal body blotches which are separated into two longitudinal rows along each side of the vertebral line. Dorsal tail markings separated medially, not fused into chevrons ;⁴ ground color above grayish-brown, tinted with yellow-green laterally in some males and all gravid females ; dorsal markings on rear legs circular in shape, not forming bands. Maximum snout-vent length 70.8 mm. (av. 61 mm.) ; tail longer than body in 82 per cent of males, shorter than body in 98 per cent of females ; femoral pores 13 to 20 (av. 15.7) ; lateral abdominal markings small black spots from 1 to 6 in number when present.

Description of Type. Head rather blunt, moderately high, outline in lateral profile a convex curve from occipital region to snout ; dorsal head scales rugose, pitted ; interorbitals and frontals slightly larger than surrounding head scales ; five internasals ; 2-2 canthals ; 6-6 superciliaries ; enlarged supraoculars about 15 to 17 in number, not greatly

⁴Refers to the subcaudal spots so well developed in this form.

enlarged nor in distinct rows ; very rugose, granular circumorbitals completely encircling supraoculars on left side but not on right ; 2-1 preoculars, 1-1 suboculars, 2-3 postoculars, all distinctly keeled ; interparietal subcircular, somewhat rugose, parietals slightly larger than adjacent scales, and forming interorbital semicircles which reduce to one medium sized scale between the orbits ; labial region flared ; five imbricate and keeled supralabials on both sides ; rostral triangular when viewed from front, strongly overlapped by first supralabial on each side, with lateral margins reaching to second infralabials ; lower labials both eight to points opposite last enlarged upper labials ; mental small, rectangular ; postmental wider than mental, triangular, with apex posterior ; symphyseal fold present, 3.1 mm. long, with granular scales between ; lorilabials enlarged, one row wide anteriorly, increasing to three rows opposite angle of mouth ; remainder of gular region with scales subequal in size, decreasing slowly in size posteriorly ; two gular folds, the anteriormost shallow with granular scales within its depression ; posterior gular fold bordered anteriorly by enlarged mesoptychials overlying the minute granular scales within the fold. The fold extending up on either side of the body slightly anterior to the insertion of the forearm, and terminating low on the shoulder ; scales of trunk gradually increasing in size and flatness toward the vertebral line ; scales along vertebral line one to two times the size of laterals ; scales along lateral dermal fold slightly enlarged when compared to adjacent lateral and ventral scales ; scales on dorsal surface of body non-imbricate, flattened and slightly concave—laterally they become less flattened and cone-like ; minute nodules present between larger dorsals ; scales on outer surfaces of legs strongly keeled, on inner faces not ; scales on femur enlarged anteriorly, decreasing in size posteriorly to become granular on rear face of leg, then abruptly increasing in size at the femoral-pore line ; ventrals about three times the size of middorsal scales, flat and smooth ; scales on soles of feet keeled ; tail with slightly keeled scales proximally, increasing in rugosity distally, many scales with dark pits. Tail fractured below at fifth subcaudal spot.

Ground color above grayish-brown with two series of nine very distinct light-edged dark brownish-black blotches which are concave anteriorly, convex posteriorly, and extend on each side of the vertebral line from occiput to base of tail. Lateral to each two dorsal series is an adjacent row of blotches similar to the dorsal blotches in color, but slightly less well defined and somewhat serrate posteriorly—these extend to the lateral fold and disappear ; tail with ten pairs of blotches, the first six split medially, the next two fused, and the last two unequally juxtaposed. Head with dark frontal spot, and two pairs of dark transverse bands bordering the supraocular region (rear bands broken

medially) ; neck with a pair of elongate dark blotches lateral to the first set of dorsal body blotches ; front and hind limbs marked with light-bordered subcircular blotches; legs immaculate white below ; venter white with a dark suffusion on chin, throat, and chest ; underside of tail with seven well defined black spots and five less well defined concentrations of dark pigment ; two postanal black spots on the hemipenial enlargement of tail ; a series of eight enlarged postanal scales; and five small, black, lateral abdominal spots—three on the right, two on the left (with faint indication of third).

Snout to vent 70.8 mm. ; tail 69.8 mm.; hind leg 53.5 mm. ; (ratio, hind leg to snout-vent measurement 1.32) ; femoral pores 18 (L), 20 (R) ; lamellae on fourth toe 25 (L), 25 (R) ; ventrals from gular fold to anus 69.

Comparisons. *Holbrookia lacerata subcaudalis* differs from *H. l. lacerata* in having a higher average femoral-pore count (15.7 in 62 *subcaudalis*; 12.8 in 68 *lacerata*) ; a high percentage of specimens (85.9) with unf used pairs of blotches on each side of the median dorsal (vertebral) line ; a pattern of rounded blotches on the hind legs, not dark bands ; and a larger average adult size (SV length 62 mm. in male *subcaudalis*, 54 mm. in male *lacerata*).

From *Holbrookia propinqua*, *H. l. subcaudalis* differs in having sub-caudal spots; paired dorsal dark markings on tail instead of fused chevrons ; small lateral abdominal black spots (not bars), extremely variable in number ; scales along vertebral line enlarged, flattened, sometimes concave, infrequently keeled ; well defined dark body blotches entirely bordered by white scales, and without superficial white speckling in males ; head high, blunt, not depressed, frontal region highly convex in lateral profile.

Habits and Habitat. The extreme wariness of these lizards is paralleled by few other North American lacertilians. Both sexes frequently choose a small pebble, dirt clod, or similar object on which to perch. At the least sign of disturbance they scamper for cover and do not stop until adequate protection is reached. My most successful collecting has been in freshly plowed fields where cover was at a minimum. Individuals found under such circumstances can be run down by the collector. The lizards tire after a 50 to 100 yard run, often over a zigzag course, and will assume a defensive stand with the mouth wide open. A finger approaching too close will provoke the little animal into leaping perhaps six inches upward at the menacing member. In the laboratory, when antagonized by another lizard, I have often seen one arch its tail upward

and wave it from side to side, as do the other Sand-Lizards (Smith, 1946) possessing subcaudal dark markings (*Holbrookia texana* and members of the genera *Callisaurus* and *Uma*). I have never observed this tail waving reaction in any *Holbrookia* which does not have sub-caudal markings.

A method of rapid burial beneath the ground surface, which may be used as an escape mechanism or as a means of achieving a suitable nocturnal retreat, has been given the name "sand swimming," and has been described with reference to the genus *Uma* (Stebbins, 1944). I have had the opportunity to observe *Holbrookia texana*, *H. propinqua*, most *H. maculata* and both subspecies of *H. lacerata* practice a similar, if not identical, type of activity which I have termed "shimmy burial" (unpublished M.A. thesis). In *Holbrookia* the burying procedure begins with the lizard stepping backward one or two steps as if anticipating something, the head is then ducked downward, the forelimbs are appressed to the body, and the animal begins to sink into the substrate as it moves its flattened body rapidly from side to side while pushing with its hind legs. When the head and body are entirely buried, the tail, which is always the last extremity to go under, twitches several times and disappears. Once the lizard is buried completely, it ceases further movement. According to Stebbins, *Uma* may "swim" beneath the surface for some distance.

H. l. subcaudalis is a very active, diurnal animal, which ceases activity when the ground temperature falls much below 28 degrees centigrade (82° F.). Time of activity varies with the season, but daily activity seems primarily dependent upon ground temperature and the velocity of the wind which acts to moderate the surface temperature. Individuals are usually most active between ten and twelve in the morning and less so from three to five in the afternoon.

Egg laying apparently takes place twice a year, with the first clutch being deposited in May and June and the second in July and August. Most females collected early in the year were found, upon examination, to have two complements of eggs, one group of large ova and a second group of small ones. The number of eggs laid at one time per female depends on the age of the female. A yearling will probably lay from four to six eggs during her first oviposition and from five to seven during the second. An adult female will lay from seven to twelve eggs at each ovipositing period. This information has been gleaned from examination of nine preserved females, four of which were small (SV 53-55 mm.), presumably yearlings, and five larger individuals (over 55 mm.) which were considered one year old or older. Two captive females deposited

nine and twelve eggs on August 23 and June 25, respectively. The nine eggs laid in August hatched from October 1 to October 4, inclusive. The twelve eggs deposited in June hatched from July 31 to August 2. The average length of the eggs laid in August was 14.6 mm of those in June, 12.9 mm. Mean snout-vent length of the lizards hatched during October was 21 mm., and the twelve hatched in July and August was 20.4 mm. The eggs and young were slightly larger when the number of eggs per female was smaller.

A reddish nuptial coloration is evident in gravid females of *Holbrookia maculata*, *propinqua*, and *texana*, as has been pointed out by Axtell and Wasserman (1953). In contrast, females of *H. l. subcaudalis* do not exhibit a reddish coloration when gravid, but instead assume a yellow or greenish-yellow hue. In some regions the males become somewhat yellowish during the mating season ; in other areas they show no perceptible color change aside from becoming lighter or darker as temperature and light fluctuate.

SPECIMENS EXAMINED

Holbrookia lacerata subcaudalis 76).

TEXAS: *Dimmit* Co.-13.4 mi. s.w. Carrizo Springs (RWA 852) ; 14.6 mi. s.w. Carrizo Springs (RWA 853) ; 17 mi. s.w. Carrizo Springs (RWA 859). *Duval* Co.-9 mi. e. Freer (RWA 582) ; 14 mi. w. San Diego (RWA 126). *Karnes* Co.—Kenedy (RWA 860) ; 6.1 mi. s.w. Kenedy (RWA 862) ; 2.2 mi. s.w. Falls City (RWA 861). *Kleberg* Co.-7 mi. n.e. Riviera (RWA 479-82, 435-9) ; 9 mi. e. Riviera (RWA 770-72). *La Salle* Co.—(near) Cotulla (USNM 32899) ; 7.5 mi. e. Encinal (RWA 635). *Live Oak* Co.—Three Rivers (BCB 2353). *Nueces* Co.-1 mi. s. Bishop (RWA 124, 139, 440-41, 477-8, 525-6, 572-7, 578-80, 673-5, 765-9) ; 1 mi. e. Bishop (RWA 483, 527) ; 1 mi. s.e. Bishop (RWA 125, 138, 140-46, 161, 206, 571, 641, 676-7) ; 2.5 mi. n.e. Bishop (RWA 484) ; 2.5 mi. w. Bishop (RWA 687) ; 4.8 mi. e.n.e. Bishop (TNHC 20000) ; 10 mi. s.e. Corpus Christi (WWM). *San Patricio* Co.—Sinton (USNM 81988). *Starr* Co.—Falcon Heights, nr. dam (RWA 851). *Webb* Co.-10.7 mi. s.s.w. Encinal (RWA 863).

MEXICO: *Coahuila*—*Gloria* (AMNH 69617) ; Sabinas (USNM 46697) ; 7.3 mi. n.n.e. Nueva Rosita (RWA 971-3).

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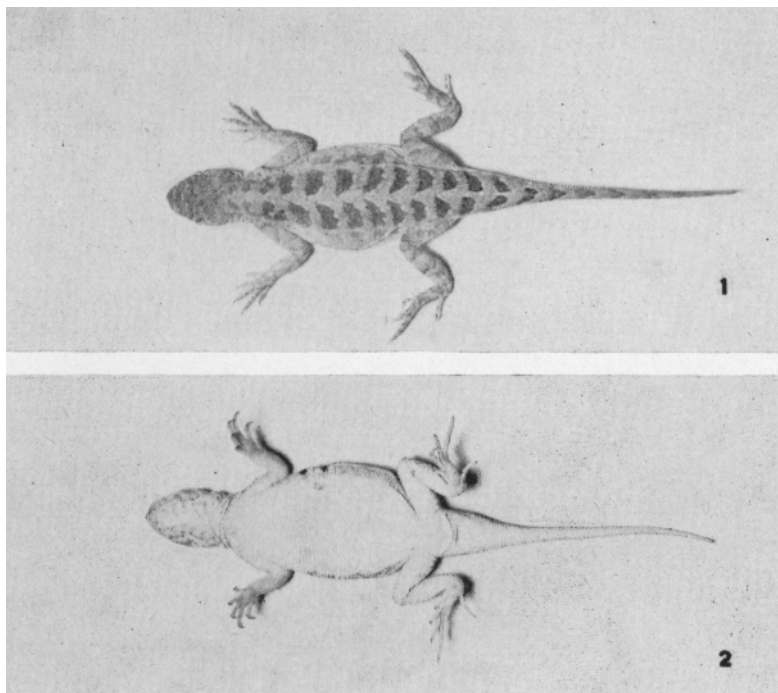


Figure 1. *Holbrookia maculata perspicua*, adult female, total length 105 mm., 9 mi. s.w. Fort Worth, Tarrant Co., Texas. RWA 856.

Figure 2. *Holbrookia maculata perspicua*, same as Figure 1. Ventral view. Photographs by Isabelle Hunt Conant.

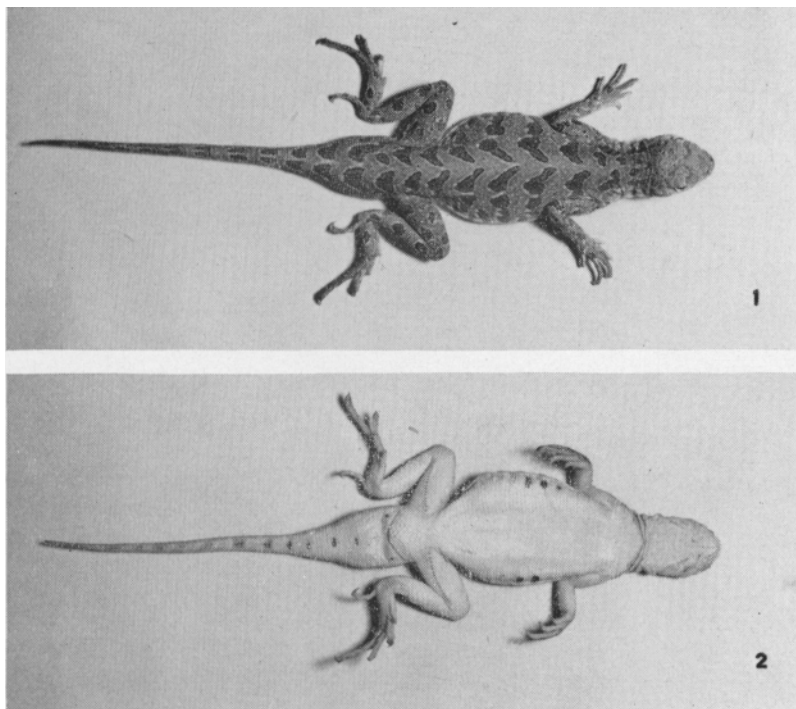


Figure 1. *Holbrookia lacerata subcaudalis*, holotype, adult male, total length 140.6 mm., 4.8 mi. e.n.e. Bishop, Nueces Co., Texas. TNHC 20,000.

Figure 2. *Holbrookia lacerata subcaudalis*, holotype, same as Figure 1. Ventral view. Photographs by Isabelle Hunt Conant.